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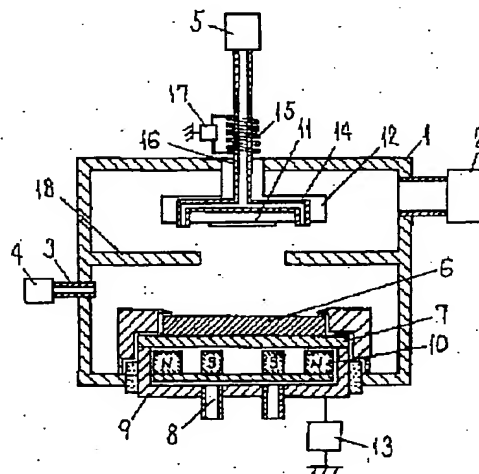
(54) REACTIVE SPUTTERING DEVICE

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(57) Abstract:

PURPOSE: To provide the reactive sputtering device which suppresses the formation of the compd. by the reaction of the target material on a target surface and reactive gas and improves the thin film forming speed by reactive sputtering in the reactive sputtering device to be used for the process for production of semiconductors and the process for production of electronic parts materials, etc.

CONSTITUTION: A substrate holder 12 is provided with plural small holes 14 and the reactive gas 5 is introduced into a coil 15 for electric discharge connected with a high-frequency power source 17 and is supplied as activated radicals into a chamber 1 from the small holes 14. A discharge gas 4 is supplied from near the target 6 and the respective gases are separately distributed by a differential pressure plate 18. The reactive gas is distributed to the parts exclusive of the target and the formation of the compd. with the target material on the target surface is therefore suppressed. Sputtering is thus executed without lowering the forming rate of the compd. thin films.



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CLAIMS

[Claim(s)]

[Claim 1] The inside of the chamber which can maintain a vacuum, and a chamber the vacuum pump for making it reduced pressure atmosphere, the magnetron type cathode fixed in the chamber, the target attached in the aforementioned cathode, and within a chamber And the substrate electrode holder which is arranged so that the aforementioned target may be countered, has two or more stomata, and carries out installation fixation of the substrate, The 1st gas supply system for supplying a discharge gas in a chamber, and the coil for electric discharge for changing reactant gas into a radical state by plasma, and supplying in a chamber, The reactive sputtering system which consists of the RF generator for being impressed by the aforementioned coil for electric discharge, the 2nd gas supply system for supplying reactant gas through the stoma of the aforementioned substrate electrode holder, a differential pressure board for keeping low the pressure by the side of a substrate electrode holder, and a power supply that impresses voltage to the aforementioned cathode.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the reactive sputtering system used for manufacturing processes, such as a semiconductor manufacture process and electronic-parts material.

[0002]

[Description of the Prior Art] By adding reactant gas, such as oxygen, to discharge gases, such as argon gas used in the usual sputtering system, a reactive sputtering system generates a compound thin film by the reaction of reactant gas and the spatter particle emitted from target material.

[0003] Since a reactive sputtering system can form various compound thin films in the usual sputtering system easily only by adding reactant gas, it is used for manufacturing processes, such as a semiconductor manufacture process and electronic-parts material, in recent years.

[0004] Hereafter, the conventional reactive sputtering system is explained with reference to a drawing. Drawing 4 is the block diagram of the conventional reactive sputtering system.

[0005] The evacuation mouth for 1 discharging a chamber and 2 discharging the air in a chamber 1 in drawing. The gas supply pipe with which 3 supplies a discharge gas 4 and reactant gas 5 in a chamber 1. The back up plate to which 6 fixes a target to and 7 fixes a target 6. The pipe of the cooling water for 8 cooling a target 6, the main part of a cathode in which 9 has the pipe 8 of a target 6, the packing plate 7, and cooling water. The substrate electrode holder for the magnet with which 10 forms a magnetic field, the substrate which 11 counters a target 6, it is arranged and a film deposits by the spatter, and 12 holding a substrate 11, and 13 are the power supplies for impressing voltage to the main part 9 of a cathode, and generating plasma on target 6 front face.

[0006] Operation of the sputtering system which consists of the above composition is explained with reference to a drawing. First, the inside of a chamber 1 is exhausted from the evacuation mouth 2 to a high vacuum (about 10^{-7} to 10^{-8} Torr) with a vacuum pump (not shown). Next, from the gas supply pipe 3 by which the end was connected to a part of aforementioned chamber 1, a discharge gas 4 and reactant gas 5 are mixed in a chamber 1.

[0007] Here, the pressure in a chamber 1 is maintained at 10^{-3} - 10^{-2} (Torr) grade. And the plasma by the magnetron discharge occurs near the target 6 front face by operation of a magnetic field with the magnet 10 arranged in the cathode 9 furnished with the target 6, and the electric field by the aforementioned power supply 13, and a compound thin film is formed in the substrate 11 installed in the substrate electrode holder 12 by the reaction of the spatter particle and the aforementioned reactant gas 5 which were emitted from the target 6.

[0008] In addition, generally having produced the combination by the spatter particle and the reactant gas in reactive sputtering mainly on a substrate is known.

[0009]

[Problem(s) to be Solved by the Invention] However, since the conventional reactive sputtering system supplies a discharge gas and reactant gas in a chamber from the common gas supply pipe, reactant gas is distributed also over the erosion of the target which becomes the highest [plasma density] in a magnetron discharge, and the compound by the reaction of target material and reactant gas is formed in a target front face. The sputtering yield of this compound has the trouble that it will generally be lower than the sputtering yield of target material, and discharge of the spatter particle

from a target will be barred with this compound, a sputtering yield will fall, and the formation speed of a thin film will fall to about 1/5 of the formation speed of the thin film of the usual sputtering / three to 1/5.

[0010] this invention solves the above-mentioned trouble and aims at offer of the reactive sputtering system which raises the thin film formation speed by reactive sputtering.

[0011]

[Means for Solving the Problem] In order to attain this purpose, the reactive sputtering system of this invention is supplied through the stoma which changes reactant gas radically and a substrate electrode holder has while it prepares the feeder of reaction system gas and a discharge gas separately and prepares two or more stomata in a substrate electrode holder. Moreover, a differential pressure board is formed, and it constitutes so that the pressure by the side of a substrate electrode holder may be kept low.

[0012]

[Function] Since the pressure by the side of a substrate electrode holder is kept low with a differential pressure board in order to supply a discharge gas from a part of chamber by the side of a target and to supply reactant gas from a substrate electrode holder by this composition and, the great portion of gas which contributes to the plasma by the magnetron discharge in which reactant gas stops mixing in a target side, and is formed near the target front face will be occupied by the discharge gas, and the compound by the reaction of target material and reactant gas becomes is hard to be formed in a target front face. Moreover, in order to change the reactant gas to supply radically and to supply it, the reaction on the front face of a substrate becomes easy to occur. Therefore, the fall of thin film formation speed can be suppressed.

[0013]

[Example] Hereafter, the reactive sputtering system of one example of this invention is explained, referring to a drawing.

[0014] Drawing 1 is the composition cross section of the reactive sputtering system of the example of this invention. The same sign is given to the portion which has the same function as the conventional example of drawing 4 here, and explanation is omitted. The coil 15 for electric discharge for differing from the conventional example forming two or more stomata 14 in the substrate electrode holder 12, and changing reactant gas 5 into a radical state by plasma, Form the power supply 17 for impressing voltage in the ends of a coil, and the gas introduction pipe 16 for supplying reactant gas in a chamber 1 is connected to the stoma of the substrate electrode holder 12. It is the point of having formed the differential pressure board 18, having installed the gas introduction pipe 3 which supplies a discharge gas 4 in the target side, and having arranged the vacuum pump 2 on the substrate side.

[0015] Drawing 2 is the cross section of the substrate electrode-holder portion of this equipment, and drawing 3 is the plane-cross-section view which looked at the substrate electrode-holder portion of drawing 2 to vertical facing up.

[0016] Operation of the reactive sputtering system of this invention constituted as mentioned above is explained.

[0017] The inside of a chamber 1 is exhausted until it becomes a high vacuum (about 10 to 7 Torrs) with evacuation mouth 2 vacuum pump (not shown). Next, a discharge gas 4 is supplied in a chamber 1 from the gas supply pipe 3. A discharge gas is confined in the target 6 neighborhood with the differential pressure board 18.

[0018] On the other hand, with the coil 15 for electric discharge to which voltage was impressed by the power supply 17, it is activated and reactant gas 5 is supplied in a chamber 1 from the stoma 14 of the substrate electrode holder 12 as radical. The supplied radical is shut up near a substrate electrode holder with the differential pressure board 18.

[0019] The pressure in the chamber 1 at this time is maintained at 10^{-3} - 10^{-2} (Torr) grade. And a RF is impressed to the magnetron cathode 9 which attached the target 6 by the power supply 13, and the plasma by the magnetron discharge occurs near the target 6 front face by operation with a magnetic field with the magnet 10 installed in the magnetron cathode 9, and the electric field by the power supply 13. Since a discharge gas is supplied from the target 6 neighborhood and reactant gas is distributed [except near the target 6] with the differential pressure board 18, in this example, the

discharge gas is mainly distributed over about six target, and the great portion of gas which contributes to generating of the plasma by the magnetron discharge formed near the front face of a target 6 becomes it with a discharge gas 4 by it.

[0020] On the other hand, since reactant gas 5 is distributed in addition to about six target, the compound with the target material formed in the front face of a target 6 becomes that it is hard to be formed.

[0021] Therefore, a spatter particle can perform sputtering, without the formation speed of the compound thin film formed in a substrate 11 falling, in case it reacts with the reactant gas activated on the substrate 11.

[0022]

[Effect of the Invention] As mentioned above the reactive sputtering system of this invention Since it is constituted so that the supply position of reactant gas and a discharge gas is prepared separately, it may supply as radical from two or more stomata of a substrate electrode holder which activated especially reactant gas, a differential pressure board may be formed and mixing of gas may be prevented, Since the great portion of gas which contributes to the plasma by the magnetron discharge formed near the target front face is occupied by the discharge gas, the compound of the target material and reactant gas which bar discharge of the spatter particle from a target becomes is hard to be formed.

[0023] Consequently, the outstanding sputtering system which suppressed the fall of the formation speed of the compound thin film formed of reactive sputtering is realizable.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The block diagram of the reactive sputtering system in one example of this invention

[Drawing 2] The cross section of the substrate electrode holder of this equipment

[Drawing 3] This plane-cross-section view

[Drawing 4] The block diagram of the conventional reactive sputtering system

[Description of Notations]

3 16 Gas introduction pipe

4 Discharge Gas

5 Reactant Gas

6 Target

9 Main Part of Cathode

11 Substrate

12 Substrate Electrode Holder

13 RF Generator

14 Gas *****

15 Coil for Electric Discharge

17 RF Generator

18 Differential Pressure Board

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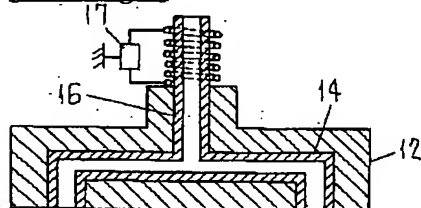
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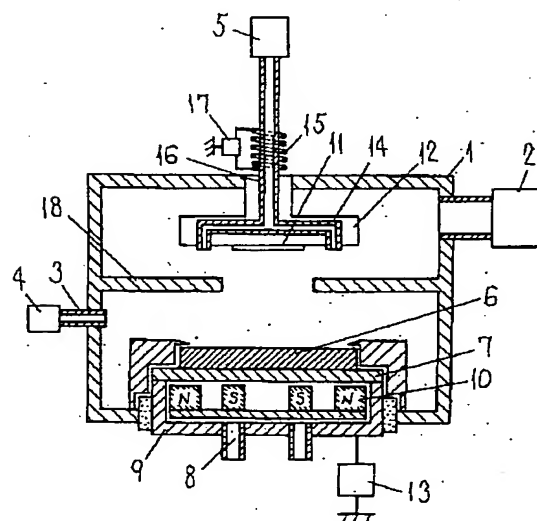
DRAWINGS

[Drawing 2]

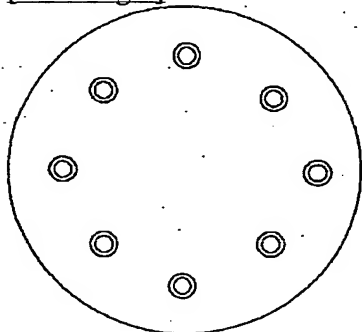


[Drawing 1]

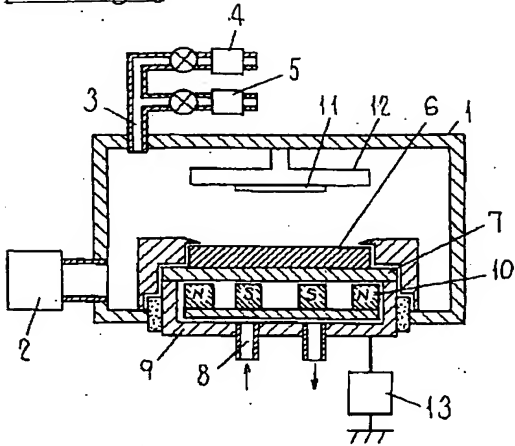
1, 16 --- ガス導入管
 4 --- 放電ガス
 5 --- 反応性ガス
 6 --- ターゲット
 11 --- 基板



[Drawing 3]



[Drawing 4]



[Translation done.]